

I/333

URAT Parallax Catalog (UPC)

(Finch+, 2016)

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The URAT Parallax Catalog (UPC).

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&lt;URAT Parallax Catalog (2016)&gt;

=2016yCat.1333....0F

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Proper motions

Keywords: parallaxes - solar neighborhood - stars: distances -

stars: statistics - surveys - astrometry - photometry

## Description:

The URAT Parallax Catalog (UPC) consists of 112177 parallaxes. The catalog utilizes all Northern Hemisphere epoch data from the United States Naval Observatory (USNO) Robotic Astrometric Telescope (URAT). This data includes all individual exposures from April 2012 to June 2015 giving a larger epoch baseline for determining parallaxes over the 2-year span of the First USNO Robotic Astrometric Telescope Catalog (URAT1) (Zacharias et al., 2015, Cat. I/329) published data. The URAT parallax pipeline is custom code that utilizes routines from (Jao, C.-W., 2004, PhD thesis Georgia Stat), the JPL DE405 ephemeris and Green's parallax factor (Green, R.M., 1985, Spherical Astronomy) for determining parallaxes from a weighted least-squares reduction. The relative parallaxes have been corrected to absolute by using the distance color relation described in (Finch et. al, 2014, Cat. J/AJ/148/119) to determine a mean distance of all UCAC4 reference stars (R=8-16 mag) used in the astrometric reductions.

Presented here are all significant parallaxes from the URAT Northern Hemisphere epoch data comprising of 2 groups: a) URAT parallax results for stars with prior published parallax, and b) first time trigonometric parallaxes as obtained from URAT data of stars without prior published parallax. Note, more stringent selection criteria have been applied to the second group than the first in order to keep the rate of false detections low. For specific information about the astrometric reductions please see 'The First U.S. Naval Observatory Robotic Astrometric Telescope Catalog' published paper (Zacharias et al., 2015AJ....150..101Z, Cat. I/329).

For complete details regarding the parallax pipeline please see 'Parallax Results From URAT Epoch Data' (Finch and Zacharias, 2016, AJ, in press).

This catalog gives all positions on the ICRS at Epoch J2014.0; it covers the magnitude range 6.56 to 16.93 in the URAT band-pass, with

an average parallax precision of 4.3mas for stars having no known parallax and 10.8mas for stars matched to external parallax sources. This catalog covers the sky from about North of  $-12.75^{\circ}$  declination.

This catalog was matched with the Hipparcos catalog, Yale Parallax Catalog, (Finch & Zacharias, 2016, AJ, in press), MEarth (Dittmann et. al., 2014ApJ...784....2M) and the SIMBAD database to obtain known parallax and star names. For stars matched to SIMBAD using the automated search feature, only the parallaxes are given so no information on the parallax errors or source for the parallax are reported for those stars in this catalog. A flag is included to show which catalog or database the URAT parallax was matched with. Only the data from the first catalog that was matched is reported here according to the following priority list. This means for example, if a star was matched with Hipparcos, that information was used while possible other catalog data are not listed here.

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# stars flg catalog
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```
53500    0 no catalog match
55549    1 Hipparcos
   254    2 Yale Parallax Catalog
  1041    3 Finch and Zacharias 2016 (UPM NNNN-NNNN)
  1431    4 MEarth parallaxes
   402    5 SIMBAD Database (w/parallax)
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112177 total number stars in catalog
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Not all parallaxes from the URAT epoch data are included in this catalog. Only those data meeting the following criteria have been included. For the epoch data we only used data having a  $\text{FWHM} \leq 7.0 \text{ pixel}$ ; amplitude between 500 and 30000ADU;  $\sigma_{x,y} \leq 90.0 \text{ mas}$ ; number of observations  $\geq 20$  and epoch span  $\geq 1.0$  years. The limits imposed on individual image amplitude, image profile width (FWHM) and position fit errors ( $\sigma$ ) are set to not allow saturated stars, stars with too few photons or poorly determined positions to be used in the parallax solution. We present all URAT parallax solutions having a known parallax from an external data source regardless of the quality of the solution ( $\text{srcflg}=1-5$ ). This was done for the user to better understand the limitations for determining parallaxes with the current URAT epoch data. For the remaining URAT parallaxes without a match to any published trigonometric parallax ( $\text{srcflg}=0$ ) we only present a parallax solutions having:

- 1) a parallax error  $\leq 10$  mas
- 2) a parallax error  $\leq 1/4$  the relative parallax
- 3) epoch span  $\geq 1.5$  years
- 4) number of observations used  $\geq 30$
- 5) fit  $\sigma \leq 1.4$  (unit weight)
- 6) average image elongation  $< 1.1$ .

All of these cuts have been implemented in an attempt to lower the number of possible erroneous parallax solutions entering our catalog.

However, the URAT reduction process does not take provisions for close doubles (blended images) of arcsecond-level separations. Many of the parallaxes, particularly those with large mean elongation, large parallax error, large fit  $\sigma$  and many rejected observations are possibly blended images leading to a higher chance of an erroneous parallax solutions. A visual inspection of all residual plots and real sky images would not be practical for the entire catalog. However, we have included information in the catalog to help the user to determine if a solution should be investigated further.

#### File Summary:

FileName	Lrecl	Records	Explanations
ReadMe	80	.	This file
upc.dat	167	112177	URAT Parallax Catalog

#### See also:

- I/238 : Yale Trigonometric Parallaxes, Fourth Edition (van Altena+ 1995)
- I/239 : The Hipparcos and Tycho Catalogues (ESA 1997)
- J/AJ/148/119 : UCAC4 nearby star survey (Finch+, 2014)
- I/329 : URAT1 Catalog (Zacharias+ 2015)

#### Byte-by-byte Description of file: upc.dat

Bytes	Format	Units	Label	Explanations
1- 6	I6	---	UPC	URAT Parallax Catalog (UPC) number
8- 18	F11.7	deg	RAdeg	Right ascension on ICRS, at Epoch J2014 (1)
20- 30	F11.7	deg	DEdeg	Declination on ICRS, at Epoch J2014 (1)
32- 61	A30	---	Name	Identifier (2)
63- 67	F5.2	mag	f.mag	URAT mean model fit magnitude (3)
69- 74	F6.1	mas	relpi	URAT relative parallax
76- 78	F3.1	mas	picor	Parallax correction
80	A1	---	corflg	[0-2] Parallax correction flag (4)
82- 87	F6.1	mas	abspi	Absolute parallax
89- 93	F5.1	mas	e_abspi	Error on absolute parallax

95-101	F7.1	mas/yr	pmRA	Proper motion in right ascension	
103-107	F5.1	mas/yr	e_pmRA	Error proper motion in right ascension	
109-115	F7.1	mas/yr	pmDE	Proper motion in Declination	
117-121	F5.1	mas/yr	e_pmDE	Error proper motion in Declination	
123-125	I3	---	ne	Total number of epochs available	(5)
127-128	I2	---	nr	Total number of epochs rejected	(5)
130-133	F4.2	yr	Espan	Epoch span of data	
135-139	F5.3	---	Elo	Average elongation of image	(6)
141-145	F5.3	---	fsig1	Fit sigma 1 (reduced chi-square)	(7)
147-151	F5.1	mas	fsig2	Fit sigma 2 (mean error indiv.obs.)	
153	A1	---	srcflg	[0-5] Source flag	(8)
155-161	F7.2	mas	srcpi	Parallax from external source	(9)
163-167	F5.2	mas	e_srcpi	Parallax error from external source	(9)

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Note (1): Positions are on the International Celestial Reference System (ICRS) as represented by the UCAC4 catalog. Mean observed positions are given at epoch J2014 (mean observed positions have been updated to J2014 using the proper motions from column ('pmRA', 'pmDE')).

Note (2): Identifier comes from the external source from which the URAT position was matched column ('srcflg'). For Mearth the LSPM North Catalog Designation is given. This is left blank if no identifier was found.

Note (3): This is the mean, observed magnitude in the 680-750 nm URAT bandpass, calibrated by APASS photometry. This bandpass is between R and I, thus further into the red than UCAC. Observations in non-photometric nights \*are\* included thus the URAT magnitudes need to be taken with caution.

Note (4): The parallax correction flag is as follows:

0 = correction from the photometric parallaxes of UCAC4 ref.stars

1 = no correction so the mean of 1.3mas was used

2 = large correction so the cut off of 3.9mas was used

Note (5): the number of epochs available in the URAT epoch data (ne) and the number of epochs rejected (nr) during the fit solutions.

Note (6): average image elongation from moment analysis, ratio of major to minor axis is given (1.0 = round)

Note (7): The error of unit weight (reduced chi-square) of the parallax fit solution is given. Thus 1.0 means the scatter of the post-fit residuals match the expected observational errors and assigned weights.

Note (8): The source flag gives the external source to which the URAT position was matched and where the information for columns 'srcpi'

and e\_srcpi are from.

0 = no match to any of the following external catalogs found

1 = matched to Hipparcos (Cat. I/239)

2 = matched with The Yale Parallax Catalog

(van Altena et al., 1995, Cat. I/238)

3 = matched with (Finch & Zacharias, 2016, AJ, in press)

4 = matched with MEarth parallaxes

(Dittmann et. al., 2014ApJ...784....2M)

5 = matched with SIMBAD database (`\protect\vrule width0pt\protect\href{http://simba`

Note (9): Parallax and error from external source. Due to the limitations of the SIMBAD database automated search feature the parallax error or the source of the parallax is not given so for all srcflg = 5, the parallax error is reported as 0.0. For all srcflg = 0, meaning no match to an external catalog the parallax and error are reported as 0.0.

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#### Acknowledgements:

Charlie Finch, `charlie.finch(at)usno.navy.mil`

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(End) Patricia Vannier [CDS] 06-Apr-2016